WE CLAIM:

1. In an apparatus for steam reforming of a vaporizable hydrocarbon the combination that includes:

a) A steam reforming reactor comprising two concentric sections including a larger outside section and a smaller inside section and an annulus containing reforming catalyst between said sections;

b) Said annulus section having an inlet for steam and vaporizable hydrocarbon, a flow path for hydrogen and by-product gases resulting from reforming reactions taking place in said annulus section, and an outlet for said by-product gases;

c) Said outside section being in heat transferring contact with said annulus section, and having an inlet for preheated air or other oxidant and a plurality of tubes for fuel gas, said tubes having openings through which the fuel gas flows and is mixed with said air or other oxidant resulting in flameless distributed combustion, whereby uniform or tailored, controlled heat is transferred to said annulus section;

d) Said inside section having a hydrogen-selective, hydrogen-permeable membrane positioned either on the inside or outside of said inside section, and an outlet for hydrogen which permeates through

said membrane from said annulus section into said inside section and passes through said outlet.

2. The apparatus of Claim 1 wherein a sweep gas is used to promote the diffusion of hydrogen through said membrane, said sweep gas being selected from the group consisting of steam, carbon dioxide, nitrogen and condensable hydrocarbon.

3. The apparatus of Claim 1 wherein the vaporizable hydrocarbon is selected from the group consisting of natural gas, methane, methanol, ethane, ethanol, propane, butane, light hydrocarbons having 1-4 carbon atoms in each molecule, light petroleum fractions including naphtha, diesel, kerosene, jet fuel or gas oil, and hydrogen, carbon monoxide and mixtures thereof.

4. The apparatus of Claim 3 wherein said reforming catalyst comprises at least one Group VIII transition metal.

5. The apparatus of Claim 4 wherein said reforming catalyst comprises nickel.

6. The apparatus of Claim 4 wherein said reforming catalyst is on a support.

7. The apparatus of Claim 6 wherein said support is selected from the group consisting of oxides, carbides, or nitrides of Group III A, IIIB, IV A, IVB, or Group VIII metals of the Periodic Table.

8. The apparatus of Claim 7 wherein said support is selected from the group consisting of porous metal oxides that are inert on their own and porous metal oxides that have the capacity to passivate the surface of a support.

9. The apparatus of Claim 1 further comprising a stinger pipe located in said inner section for introducing sweep gas into said section.

10. The apparatus of Claim 8 wherein the support comprises alumina.

11. The apparatus of Claim 10 wherein said reforming catalyst comprises nickel on alumina.

12. The apparatus of Claim 1 wherein said hydrogen-permeable selective membrane comprises one or more Group VIII transition metals or alloys thereof.

13. The apparatus of Claim 12 further comprising said hydrogen-permeable membrane is situated on a support.

14. The apparatus of Claim 13 wherein the support is selected from oxides, carbides, and nitrides of Group IIIA, IIIB, IVA, and IVB.

15. The apparatus of Claim 13 wherein the support comprises a porous metal or porous ceramic support.

16. The apparatus of Claim 13 wherein the support comprises a porous metal support.

17. The apparatus of Claim 15 wherein the support comprises alumina.

18. The apparatus of Claim 15 wherein the support comprises porous stainless steel or Hastelloy or Inconel.

19. The apparatus of Claim 13 further comprising said membrane support provides an intermediate layer between the membrane and the catalyst.

20. The apparatus of Claim 19 further comprising the membrane support serves as a thermal insulating layer to assist in keeping the membrane at a desired temperature.

21. The apparatus of Claim 20 further comprising the support is alumina and the concentration of alumina permits the tailoring of the design to emphasize insulating or conducting properties.

22. The apparatus of Claim 12 wherein said hydrogen-permeable membrane is selected from palladium and palladium alloys.

23. The apparatus of Claim 22 wherein said hydrogen-permeable membrane comprises at least one of an alloy of Pd with 30-50 wt% copper, an alloy of Pd with 5-30 wt% silver, an alloy of Pd with 1-10 wt% yttrium, an alloy of Pd with 1-10%w holmium, an alloy of Pd with 10%w gold, an alloy of Pd with 1-10%w ruthenium and an alloy of Pd with 1-10 wt% cerium.

24. The apparatus of Claim 12 wherein the hydrogen-permeable selective membrane is selected from platinum and platinum alloys.

25. The apparatus of Claim 12 wherein said membrane has a thickness in the range of 10 Angstroms to 150μm.

26. The apparatus of Claim 25 wherein said membrane has a thickness in the range of 0.1 to 20μm.

27. The apparatus of Claim 26 wherein said membrane has a thickness in the range of 0.5 to 10μm.

28. The apparatus of Claim 27 wherein said membrane has a permeability in the range of $8 \times 10^{-4}$ to 80 standard cubic meters/$m^2$/sec/bar $^{½}$.

29. The apparatus of Claim 1 further comprising said steam reformer functions alone as a hydrogen generator to supply a source of hydrogen for any process requiring a source of hydrogen.

30. The apparatus of Claim 29 wherein said steam reformer functions alone as a hydrogen generator to supply a source of hydrogen for any process selected from the group consisting of production of ammonia, production of electricity, refining, semiconductor processing, hydrogen peroxide manufacture, hydrogenation of chemical intermediates and production of hydrogen for chemical analytical testing.

31. The apparatus of Claim 1 further comprising the apparatus for steam reforming is in communication with a fuel cell.

32. The apparatus of Claim 31 wherein the fuel cell is a high pressure fuel cell.

33. The apparatus of Claim 32 wherein the fuel cell is a high pressure molten carbonate fuel cell.

34. The apparatus of Claim 31 wherein said steam reformer is scalable and easily adjustable to any size fuel cell.

35. The apparatus of Claim 34 wherein said steam reformer is mobile and lightweight.

36. The apparatus of Claim 1 characterized in that nitrogen oxide formation is reduced to less than 10 ppm.

37. The apparatus of Claim 36 wherein nitrogen oxide formation is reduced to less than 1.0 ppm.

38. The apparatus of Claim 37 wherein nitrogen oxide mation is reduced to less than 0.1 ppm.

39. The apparatus of Claim 1 wherein said steam reformer is constructed of less expensive materials, containing less chromium and nickel, not suitable for similar steam methane reformers in the art which must operate at higher temperatures.

40. The apparatus of Claim 39 wherein said steam reformer is constructed of an alloy containing less than 25% Cr and less than 20% Ni, with most of the balance comprising iron.

41. The apparatus of Claim 40 wherein the alloy contains about 15 to 20% Cr and about 5 to 15% Ni.

42. The apparatus of Claim 41 wherein the alloy is AISI 304 stainless steel, comprising about 18% Cr, about 8% Ni, and the most of the balance Fe.

43. The apparatus of claim 2 wherein the sweep gas is steam.

44. The apparatus of claim 1 further comprising said inside section is packed with a methanation catalyst to react with any trace amounts of CO present in the hydrogen which permeates through said membrane.

45. The apparatus of claim 1 wherein between 90 and 95% of the heat generated by the flameless distributed combustors is transferred to said annulus section containing said reforming catalyst.

46. The apparatus of claim 33 wherein the combined steam reformer-molten carbonate fuel cell apparatus has a 71% or greater efficiency in the generation of electricity from the vaporizable hydrocarbon fuel gas.